camp 1 woman was killed and 30 or more people were injured. It is estimated that 2,000,000 feet of timber was blown down, of which at least a third will be a total loss.

An unusual feature of the storm noted in this section was the absence of rain during its passage. A great glow lighted up the sky as the storm approached, and heavy hail was reported to the northwestward, but with the storm itself there was no precipitation.

Near Magnet Cove, Hot Springs County, one man was killed and four other members of his family were injured. In this neighborhood the storm cut a swath nearly a mile wide, twisting the timber and doing much damage to homes and other buildings. A little farther northeastward in Garland County another life was lost, this being the last loss of life reported.

Two years ago the Magnet Cove community was visited by a heavy wind, and this tornado seems to have followed almost the exact path made two years ago.

Heavy precipitation.—The passing of the LOW in which these tornadoes occurred brought excessive rains in Arkansas the 16th, 17th, 18th, and 19th.

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GREAT ICE STORM OF NOVEMBER 26–29 IN MASSACHUSETTS.

A shallow barometric depression (30.10 inches) developed during the night of the 26th–27th over the Atlantic directly south of Nantucket. This depression was formed in a bend of the isobar of 30.20 inches surrounding an anticyclone (30.50 inches) central over the mouth of the St. Lawrence. The gradients were therefore for northeast to north winds over New England, with rain and snow, depending upon the temperature. The northern HIGH gave way somewhat during the 27th, and by the morning of the 28th a large cyclone with central pressure 29.50 inches in southwestern Virginia occupied practically the whole of the New England and Middle Atlantic States and the western portion of the Canadian maritime provinces. By this time the snow of the first depression had changed to rain, which was general from Virginia to the Maine coast, snow falling only in the interior of Maine. The Virginia cyclone moved northeastward to the Atlantic south of New England by the morning of the 29th, and continued in a course to the northeast over the Atlantic. So much for the weather maps during the storm period. The following is quoted from a letter to the editor from Mr. Royal Robbins, Boston, Mass.:

> The storm caused a snowfall of over 2 feet in northern New England, and heavy rain with some snow in the southern portion of New England. Over an area of perhaps 3,600 square miles, 60 miles west and north from Boston, this heavy rain froze as it fell for parts of three days, resulting in the most severe ice storm within living memory. Rain fell for many hours, with a temperature of 26° (F.) and a total precipitation of more than 3 inches of rain.
>
> Over this large area, chiefly in northeastern Massachusetts, where the rain froze as it fell, the damage probably exceeded that of any storm on record in the same territory. The loss to telegraph, telephone, and electric lighting companies is estimated at over 5 million dollars, while more than 100,000 trees were ruined. The value of the latter is difficult to compute, but would probably reach 5 or 10 million dollars more. The loss of this great number of beautiful trees in cities and towns is irreparable.
>
> While several gales occurred off the coast, the winds in the ice area did not exceed 30 miles per hour, so that the actual weight of ice was the chief cause of the great damage. The weight on the wires is said to have been about 2 tons between telegraph poles, 2,700 of which poles fell on one railroad in the 60 miles immediately west of Boston. The area of destruction was bounded on the north by the region where the precipitation was entirely snow; and on the south and west by the region where the rain did not freeze.

Dr. C. F. Brooks and Mr. G. F. Howe, writing in the *Bulletin of the American Meteorological Society*, give the following account of the storm as experienced at Worcester, Mass.:

> Even the "oldest inhabitant" admits the ice storm of November 26–29 was the worst that has been known in this section. The ice and sleet which collected on Thanksgiving Day were practically gone when the storm started. Friday was brilliantly clear till late afternoon, and Saturday morning the sky was covered with a thick, snowy, alto-stratus cloud. Snow began to fall at 2 p. m. and continued heavily until 4:45 p. m., when it changed to rain. The temperature of wet surfaces remained below freezing and the rain froze, forming a crust on the snow. Sunday it rained till afternoon, when sleet and moderate rain fell intermittently. The temperature fell to 25° F. in the evening. About 10 p. m. it started to rain steadily. By Monday morning the ice which had formed on the trees was nearly an inch thick on exposed branches and many of the upper ones had broken off and fallen to the ground. The rain continued all day Monday with the rising north-northeast wind, and the temperature just below freezing. By 5 p. m. it was dangerous to walk along the street, so many limbs and wires were falling.
>
> A wild night followed. Sleet rattled and rain pattered and the ice-laden trees creaked continuously. With the passage of each roaring gust, down crashed great branches from trees. The low clouds were intermittently lighted by vivid green flashes from trolley wheels. At daylight a thunderstorm with pink flashes of lightning awakened the people to a scene of sad destruction. Pelting rain and sleet continued to drive by at high speed. The heavy rain which fell Monday night did not freeze as much as that which fell previously, except where the wind was uninterrupted, as the lowest temperature was 28. This water combined with a new fall of 1½ inches of sleet and the previous ice, covered thoroughfares with 5 inches of slush and water. The thunderstorm on Tuesday morning announced the approach of the end. By Tuesday noon there was hardly a tree that had not lost at least one good-sized branch. Ice on exposed ordinary insulated electric wires about one-fourth inch in diameter was more than 2 inches thick, and weighed upward of 1.3 pounds per foot.[1] It was computed that ice on the side of any dense, unbroken evergreen tree 50 feet high and on the average 20 feet wide would have weighed 5 tons. Large crews were kept busy keeping the main thoroughfares cleared of the débris. Telephones, electric lights, telegraphs—everything was out of order. Whole lines of telephone and trolley poles were snapped at the base, crippling both services. For days trolleys did not run in many places and trains were hours late, as the crews had to stop to remove poles from the track. Schools were closed and mail service was badly interrupted. Several people were injured by falling branches and ice, and a number of horses were killed. The damage in Worcester was estimated at several hundred thousand dollars.
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> The total precipitation which fell in the 75½ hours of the storm was 4.05 inches as collected in the rain gage on the roof of the main building, Clark University. Of this, 0.28 was melted snow, and about 1.65 melted sleet. On the following day, bright sunshine soon relieved unbroken branches of some of their load of ice, though not without first inflicting further damage to some trees by expanding the ice on overweighted limbs.
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> The unusual duration of this ice storm seems to have been due to a large supply of cold air flowing southwards, and of warm air going northwards above it. The cold wind at the surface, as is usual when sleet or ice storms occur, formed a barrier over which the warm wind had to rise. It was this rising and the consequent cooling by expansion which reduced the vapor capacity of the wind aloft and thus produced rainfall. The two currents in this case were surprisingly well balanced. The temperature of the lower one did not rise enough above freezing to prevent the continued formation of ice, while the wind above, after the first fall of snow, remained continuously so much above freezing that all the precipitation from it was in the form of rain.
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> It was interesting to note that the conditions which gave the big ice storm here also caused very severe ice storms in Oregon and Washington on November 20 and 21, said to be the worst since 1916, and destroyed thousands of orchard trees.

—*A. J. H.*

ANALYSIS OF SUMMER PRECIPITATION AT MOUNT VERNON, IOWA.

By W. A MOORE and DONALD CORLETT.
[Cornell College, Mt. Vernon, Iowa.]

The following table gives the results of chemical analyses of rains which fell at Mount Vernon, Iowa, during the summer of 1921, in parts per million.

[1] A piece of ice 9.5 inches long, which had fallen from an electric wire on the south side of Coes Pond, was picked up on the morning of Dec. 11. It weighed exactly 1 pound The ice was 1.8 to 2 inches thick and 2.3 to 2.6 inches wide.

Date	June 20 (night).	June 25 (night).	June 27 (a. m.).	June 27 (p. m.).	July 4 (p. m.).	July 14 (night).	July 18 (a. m.).	July 28 (night).	Aug. 1 (day).	Total.
Wind direction	E.	E.	E.	E.	SE.	SE.	SE.	E.	NE.	Total.
Total precipitation (in.)	0.25	0.42	0.90	0.30	0.22	0.49	0.77	0.10	1.53	.....
Alkalis	210.	16.0	184.0	18.0	4.60	154.23	18.00	None.	116.0	720.83
Chlorine	14.2	17.5	16.3	14.25	14.26	7.10	13.40	17.75	14.2	128.96
Nitrites	.006	.004	.004	.004	.01	.011	Trace.	Trace.	Trace.	.039
Nitrates	.055	.05	.04	.06	.04	.03	.06	.01	.001	.346
Albuminoid ammonias	.02	27.0	28.00	8.00	18.60	10.80	14.00	.....	4.80	92.62
Free ammonias	.40	11.0	12.00	3.00	14.20	8.40	1.36	.....	1.10	52.26
Carbon dioxide	200.	16.0	26.4	53.60	42.40	29.40	69.60	19.50	26.25	483.15
Sulphates	118.8	75.20	52.60	60.04	5.30	72.70	283.40	23.00	25.00	616.04

NOTES, ABSTRACTS, AND REVIEWS.

Miss Frederica Boerner.

We regret to announce the death of Miss Frederica Boerner, at Vevay, Ind., on October 27, 1921.

Miss Boerner was the daughter of Charles G. and Josephine Boerner. She came with her parents from Ohio to Vevay when she was a mere child and spent practically her lifetime in that place.

On the death of her father in 1900, she succeeded him as cooperative weather observer, and has maintained the record with a few unimportant lapses due to illness for upward of 20 years. To the efforts of father and daughter, there is preserved to southeastern Indiana a practically unbroken record of the weather since 1865. Aside from her interest in keeping watch of the weather, Miss Boerner found time to take an active interest in the social and religious affairs of her home city. She passed away respected and loved by all who knew her.

ANNUAL MARCH OF TEMPERATURE IN SAMOA.

By G. ANGENHEISTER.

[Abstracted from *Meteorologische Zeitschrift*, Feb., 1921, pp. 47–50.]

A discussion of 30 years of observations reveals the fact that the annual march of monthly means of temperature is similar to the annual march of radiation, which may be computed by the formula

$$J = J_0(d''/960'')^2 \int \sin h \, dt,$$

where h is the altitude of the sun, t the hour angle of the sun, and d the apparent radius of the sun in seconds of arc. The integral has to be computed between sunrise and sunset. If the atmospheric extinction is taken into account, the above formula becomes

$$J = J\ (d''/960'')^2 \int q^{\frac{1}{\sin h}} \sin h \, dt,$$

where q is the extinction coefficient. As extinction does not appreciably change the character of the curves, we can disregard it.

The temperature follows radiation,[1] their apparent difference in phase being equal to from one-half to one month. They both show a deep minimum in the middle of the year and a flat maximum at the beginning. Although the sun crosses the zenith of Samoa twice a year (Oct. 30, and Feb. 12), the daily amount of radiation shows only one maximum in January, because of the variation of the length of the day. When the radiation in Samoa diminishes about 1 per cent, the mean monthly temperature (with a retardation of one month as stated above) decreases about 0.0273°C. This coefficient varies at different places on the earth's surface. Knowing this coefficient and the mean temperature of one month for a certain station, it is possible to compute with great accuracy the annual march of temperature from the annual march of radiation.[2]

It is understood that such a simple relation is to be expected only in the uniform areas of tropical oceans. For Samoa, the difference between the computed temperature and the observed one is less than 0.1°C. The mean annual amplitude (observed) in Samoa is 1.1°C. The result of the investigation of the relation between the annual march of radiation and temperature is the following: Island stations damp the influence of short-period variations of radiation, while the long-period variations, although of small amplitude, are very well expressed. The contrary is observed at the land stations.

Maximum temperature occurs in Samoa shortly after noon. For two or three hours after that time, the temperature hardly changes, the average change being no more than 0.01°C.—*J. P.*

[1] The author is here evidently considering changes in radiation due to the changing declination of the sun,—not to changes in the intensity of solar radiation.—EDITOR.

CITRUS CROP INSURANCE IN FLORIDA.

The following excerpts from the *Florida Grower* and the Tampa *Tribune* will be of interest in connection with the question of crop insurance as a possible substitute for the expensive smudging operations against frost:

Crop insurance is here at last. A Philadelphia firm * * * representing several big fire insurance companies is now prepared to write frost insurance on citrus crops. As I understand it [the representative] will write policies on individual groves or an association may take out a blanket policy on the crop of all its members. No provision is made for insuring trees, though that may come another year; it is being considered. Insurance applies only to fruit actually on the trees at time of damage and does not include injury to bloom, the policy automatically expiring on March 15. No policy goes into effect until 72 hours after it has been written. I presume this latter is to forestall applications that might be made at a time when a freeze may have been predicted by the Weather Bureau. Insurance will be confined to the south of the northern borders of Volusia, Marion, and Citrus Counties. Rates will be on a sliding scale, water protection having an influence in the rate making. The lowest rate will be 6 per cent and from that up to 8½ per cent, the insurance agent to be the judge as to the frost danger.

Great interest will no doubt be aroused among the growers at this announcement. Florida should feel honored that the plan is to be tried out here first. California will probably be considered another

[2] This study of the relation between the annual march of temperature in Samoa and the annual march of radiation is a specific example of a problem which was treated in a more general way for the whole earth by Angot, in *Annales du Bureau Central Météorologique de France*, for the year 1883, pp. B121–B169, in a paper entitled *Recherches théoretiques sur la distribution de la chaleur à la surface du globe*. The paper begins with a general bibliographic discussion, and proceeds to the development of formulae which give the heat received at the outside of the atmosphere in different seasons; next the question of atmospheric absorption is treated and the heat received at the surface with different degrees of atmospheric transparency discussed. The formula used by Angenheister above appears in essentially the same form in Angot's paper. A more detailed discussion follows in which the amount of heat received annually at each latitude from the equator to the poles, by ten-degree intervals, the heat received on the same day in different latitudes, and the total heat received during the year at different latitudes, are treated. The work is important and forms a substantial foundation for studies similar to that carried out by Angenheister.—*C. L. M.*